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Predictive dynamic relocations in carsharing systems implementing complete journey reservations

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We study the operations of station-based one-way carsharing systems that enforce a complete journey reservation policy. Under such regulation, users are required to reserve both a vehicle at the origin station and a parking spot at the destination station whenever they wish to make a trip. Reservations can be made up to one hour in advance and users do not have to specify in advance the exact pick-up and drop-off times. These attractive customer-oriented rental conditions guarantee the availability of vehicles and parking spots at the start and end of the customers' journeys but may result in an inefficient use of resources. Notwithstanding, reserved vehicles/parking spots provide information about resources that are about to become available. In this work, we develop a Markovian model for a single station that explicitly considers journey reservation information and estimates the expected near future demand loss using historical data. The output of the model is integrated in a new proactive dynamic staff-based relocation decision algorithm. The proposed algorithm was tested in the field on the Grenoble car-sharing system and compared to other dynamic and static approaches. Real-world results are reinforced by an extensive simulation experiment using real transaction data obtained from the same system.